Workshop on Modeling the Climate System at Ultra-High-Resolution

Resolving atmospheric storms, ocean sub-mesoscale eddies, rivers, and glaciers

3-7 October, NCAR, Boulder, Colorado

https://www.mmm.ucar.edu/events/2022/wcrp

Introduction

Ultra-high-resolution climate models at km-scale ('K-scale') are within our grasp and provide the potential for major advances in both climate science and its applications for societal needs. K-scale models are being developed at both regional and global scale across the world with the aim to develop fully integrated coupled modelling systems. Perhaps naturally, much of the effort so far has been divided by the spheres of the climate system, with significant activities in atmospheric, ocean, land, and ice modelling.

The main purpose of this workshop is to bring together modellers across all spheres to share progress and discuss the major challenges and opportunities in building kilometre-scale global and regional modelling systems. A particular goal of the workshop is to identify opportunities for joint experimentation and model analysis across regions and spheres.

To facilitate the exchange of ideas the workshop will include both invited and contributed presentations. Those will be complemented by a series of breakout group discussions around a common set of questions aimed at generating and sharing ideas on the practical pathways for future collaboration and research in coupled K-scale modelling.

We are looking forward to seeing you in Boulder.

Draft Agenda

Monday, 3 October

Moderator: Andreas Prein

0900-0915 **Welcome and Logistics**

0915-0945	ESMO, the Digital Earths Lighthouse activity and Workshop Goals	Christian Jakob, Andrew Gettelman, Cath Senior
0945-1030	Coupled k-scale modelling – Challenges and opportunities	Cathy Hohenegger
1030-1100	**Coffee Break**	
1100-1145	Progress and challenges on making regional climate change simulations at km-scale	Nikolina Ban
1145-1230	Progress and challenges on high resolution Atmospheric modelling with NICAM	Daisuke Takasuka
1230-1330	**Lunch**	
	Moderator: Andrew Gettelman	
1330-1415	**Contributed Talks (12+3 min each)**	
	ECMWF Km-scale modelling effort for the development of a Digital Twin of the Earth	Benoit Vanniere
	Prototyping Convection-Permitting Global Weather and Sub-Seasonal Forecast with the NOAA Unified Forecast System	Fanglin Yang

	Global large eddy simulations and their collaboration with detailed observations based on vertical atmospheric motions	Masaki Satoh
1415-1430	**Breakout Sessions Introduction**	Christian Jakob
1430-1530	**Breakout Session 1**	
1530-1600	**Coffee Break**	
1600-1730	**Contributed Talks (12+3 min each)**	
	K-Scale Project: Exploiting a global-to-regional seamless modelling strategy in the UK to advance research and applications across timescales	Huw Lewis
	The Navy Earth System Prediction System: Version 2 Developments	William Crawford
	Very high resolution coupled climate modelling with unstructured ocean model	Nikolay Koldunov
	The emergence of the mesoscale in Global Storm Resolving Models	Pier Luigi Vidale

	Using ARM Observations to Evaluate Simulated Mid-Latitude and Tropical MCSs Across the Grayzone of Convection	Andreas Prein
	Mean-state GCM biases are a predictor of precipitation biases in dynamical downscaling	Stefan Rahimi
1730-1900	**Icebreaker**	

Tuesday, 4 October

Moderator: Andrew Gettelman

0900-0945	Towards the Predicted Ocean ---- Ideas from FIO models coupled with ocean surface waves	Zhenya Song (Virtual)
0945-1030	Sea ice at the flow size scale: Is it time for new modelling approaches?	Martin Losch (Virtual)
1030-1100	**Coffee Break**	
1100-1145	Challenges of high resolution for land modelling	Martin Best
1145-1230	**Contributed Talks (12+3 min each)**	

	Ultra-high resolution atmosphere modeling in E3SM	Aaron Donahue
	Simulations With EarthWorks	David Randall
	K-Scale: Assessing the added value of explicitly modelling convection within a very-large tropical domain compared with the nested LAM approach	Richard Jones
1230-1330	**Lunch**	
1330-1500	**Breakout Session 2**	
1500-1530	**Short Plenary:** Reflections and new questions from the breakout group discussions so far	Participants
1530-1600	**Coffee Break**	
	Moderator: Cathy Hohenegger	
1600-1730	**Contributed Talks (12+3 min each)**	
	Three-Dimensional Structure of Convectively Coupled Equatorial Waves in K-scale MPAS Aquaplanet Simulations	Rosimar Rios-Berrios
	Toward Process-Resolving Fully-Coupled Arctic Climate Modeling and Prediction	Mark Seefeldt

	Hydrometeorology and terrestrial hydrology across Alaska: a high-resolution coupled land-atmosphere modeling system	Andrew Newman
	Moving land models towards actionable science: A novel application and multi-objective optimization of the Community Terrestrial Systems Model across Alaska and the Yukon River Basin	Yifan Cheng
	A Hydroclimate Project over the United States, Integrating Ultra-High-Resolution Modeling and Observational Strategies to Create a Regional Digital Earth	Timothy Schneider
	Sub-seasonal Predictability of Rainfall over the Kingdom of Saudi Arabia	Hari Prasad Dasari

Wednesday, 5 October

Moderator: Andreas Prein

0700-0830	**Online breakout session 1**	
0900-0945	Findings and insights from the DYAMOND project	Tomoki Miyakawa

0945-1030	Progress and challenges around high-resolution Earth System Prediction	Steve Yeager
1030-1100	**Coffee Break**	
1100-1145	Modeling ice sheets at ultra-high resolution	Helene Seroussi (Virtual)
1145-1245	**Contributed Talks (12+3 min each)**	Participants
	The CORDEX perspective on the ultra-high resolution modeling	Silvina Solman (Virtual)
	Towards an energy consistent coupling of the height-based Model for Prediction Across Scales Atmosphere (MPAS-A) dynamical core with the pressure-based Community Atmosphere Model (CAM) physics packages	Peter Lauritzen
	Data Assimilation for Climate	Aneesh Subramanian
	RRTMGPxx: a portable radiation code for ultra-high-resolution modeling	Benjamin Hillman
1245-1345	**Lunch**	

1345-1500	**Breakout Session 3**	
1500-1530	**Short Plenary:** Reflections and new questions from the breakout group discussions so far	Participants
1530-1600	**Coffee Break**	
	Moderator: Christian Jakob	
1600-1730	**Contributed talks (12+3 min each)**	
	NASA GEOS-ECCO-MITgcm sub-10 kilometer coupled modeling, some early results and plans	Chris Hill
	Progress towards global cloud-permitting greenhouse warming simulations	Sun-Seon Lee
	Enhanced large-scale atmospheric circulation response to Gulf Stream SST anomalies in CAM6 simulations with 14-km-resolution regional refinement	Robert Jnglin-Wills
	Development of a global km-scale atmospheric model for centennial scale simulations	Olivier Geoffroy
	Analyses of added value for heavy rainfall and strong wind in convection-permitting climate simulations over Germany	Michael Haller

	Improving Earth System Models via Hierarchical System Development	Michael Ek

In parallel: Online Breakout Session 2

Thursday, 6 October

Moderator: Cath Senior

0700-0830	**Online breakout session 3**	
0900-0945	Computational challenges and opportunities for ultra-high resolution modelling	Oliver Fuhrer (Virtual)
0945-1030	Data challenges for ultra-high resolution modelling	Milan Klöwer (Virtual)
1030-1100	**Coffee Break**	
1100-1145	AI (f)or high-resolution models ?	Laure Zanna (Virtual)
1145-1215	**Contributed Talks (12+3 min each)**	
	EarthWorks: The Computational Challenges of building an end-to-end, GPU-enabled km-Scale Modeling System	Richard Loft

	Addressing the Software Engineering Challenges within the EarthWorks Project	Sheri Mickelson
1215-1315	**Lunch**	
1315-1500	**Breakout Session 4**	Participants
1530-1600	**Coffee Break**	
1600-1700	**Breakout Group report preparations**	Participants

Friday, 7 October

0900-1030	**Breakout group reports**	Chairs and Rapporteurs
1030-1100	**Coffee break**	
1100-1230	**Workshop synthesis and wrap up**	Christian Jakob, Andrew Gettelman, Cath Senior
1400-1700	**Workshop report outlining session**	By invitation